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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/707,357	12/08/2003	SU-CHEN LAI	11595-US-PA	1356
31561	7590	08/25/2004	EXAMINER	
JIANQ CHYUN INTELLECTUAL PROPERTY OFFICE			THOMAS, TONIAE M	
7 FLOOR-1, NO. 100			ART UNIT	
ROOSEVELT ROAD, SECTION 2			PAPER NUMBER	
TAIPEI, 100			2822	
TAIWAN			DATE MAILED: 08/25/2004	

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/707,357	<b>Applicant(s)</b> LAI ET AL.	
	<b>Examiner</b> Toniae M. Thomas	<b>Art Unit</b> 2822	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 08 December 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-22 is/are rejected.
- 7) ☒ Claim(s) 23-25 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

**DETAILED ACTION**

1. This action is a first Office action on the merits of Application Serial No. 10/707,357. Currently, claims 1-25 are pending.

***Specification***

2. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

3. *Claims 1-25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.*

The claim language “an electrode formed at a bottom of the deep trench in the substrate” is ambiguous (claim 1, lines 5-6; claim 13, lines 5-6; claim 18, lines 5-6). It is unclear whether the recited claim language means: (1) an electrode is formed at the bottom of the trench formed in the substrate, or (2) an electrode is formed in the substrate at the bottom of the trench. For purposes of examination, the meaning of the claim language is interpreted as “an electrode is formed in the substrate at the bottom of the trench.”

Correction is required in response to this action.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. *Claims 18, 19, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shen (US 6,001,684) in view of Aussilhou et al. (US 6,344,673 B1).*

The Shen patent (Shen) discloses a method of fabricating a deep trench capacitor (figs. 1A-1N and accompanying text). The method comprises the steps of: providing a substrate 10, wherein the substrate has a mask layer 16 formed thereon and a deep trench 20 formed therein, an electrode 30 formed at a bottom of the deep trench in the substrate and a capacitor dielectric layer 26 formed on the surface of the deep trench (fig. 1H; col. 3, line 64 – col. 4, line 30; and col. 5, line 47 – col. 6, line 10); forming a first conductive layer 34 at the bottom of the deep trench (fig. 1H; col. 3, line 64 – col. 4, line 30; and col. 5, line 47 – col. 6, line 10); forming a collar oxide layer 35 on the surface of the first conductive layer (fig. 1I and col. 6, lines 11-16); removing the collar oxide layer on the surface of the first conductive layer (fig. 1J and col. 6, lines 17-19); depositing conductive material into the deep trench to form a second conductive layer 42 (fig. 1K and col. 6, lines 21-24); removing a portion of the

Art Unit: 2822

second conductive layer 42 at the top of the deep trench so that the second conductive layer partially fills the deep trench (fig. 1L and col. 6, lines 25-27); removing the collar oxide layer not covered by the second conductive layer (fig. 1M and col. 6, lines 28-30); and depositing conductive material into the deep trench to form a third conductive layer 43, wherein the third conductive layer completely fills the deep trench (fig. 1N and col. 6, lines 31-34).

A chemical vapor deposition (CVD) process is used to form the collar oxide layer, wherein the chemical vapor deposition process comprises using tetra-ethyl-ortho-silicate (TEOS) as a reactive gas (col. 6, lines 11-16).

Shen does not teach forming the collar oxide layer 35 on the surface of a protective layer. On the other hand, the Aussilhou et al. patent (Aussilhou) discloses a method for fabricating a deep trench capacitor (figs. 2A-2D and accompanying text), wherein the method comprises forming a collar oxide layer 18 on the surface of a protective layer 17 (fig. 2A and col. 2, lines 17-22). The protective layer is a layer of silicon oxide, as recited in claim 19 (col. 2, lines 17-22).

Since both Shen and Aussilhou are from the same field of endeavor, the purpose for which Aussilhou is relied upon would have been recognized in the prior art reference of Shen by one of ordinary skill in the art at the time the invention was made.

To protect the substrate during the formation of the collar oxide layer 35, as shown in fig. 1J of Shen, it would have been obvious to one of ordinary skill

in the art, at the time the invention was made, to modify Shen in view of Aussilhou, by forming the collar oxide layer on the surface of a protective layer, as taught by Aussilhou.

5. *Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shen in view of Aussilhou as applied to claim 19 above, and further in view of Wolf et al. (Silicon Processing for the VLSI Era – Vol. 1: Process Technology).*

The protective layer 17 of Aussilhou is a thermal oxide layer, and the collar oxide layer 18 is a TEOS oxide layer (). Whereas Aussilhou teaches forming the protective layer 17 using thermal oxidation, Aussilhou does not teach forming the protective layer using a plasma-enhanced chemical vapor deposition process (PE-CVD), as recited in claim 20.

The Wolf et al. non-patent literature reference (Wolf) discloses using PE-CVD as a method for depositing silicon oxide (page 184, 5<sup>th</sup> par, line 1 – 6<sup>th</sup> par., line 5). Oxides formed using PE-CVD are very conformal layers (page 184, 6<sup>th</sup> par., lines 3-5).

Since both Aussilhou and Wolf are from the same field of endeavor, the purpose for which Wolf is relied upon would have been recognized in the prior art reference of Aussilhou by one of ordinary skill in the art at the time the invention was made.

Wolf defines “conformal coverage” as coverage in which equal film thickness exists over all substrate topography regardless of its slope (Wolf - page 185, fig. 17a and 2<sup>nd</sup> par., lines 3-5). It would have been obvious to one of

Art Unit: 2822

ordinary skill in the art, at the time the invention was made, to modify the combination of Shen and Aussilhou in view of Wolf by forming the protective layer of oxide using a PE-CVD process, as taught by Wolf, in place of thermal oxidation, since the deposited oxide layer resulting from the PE-CVD process is formed having equal film thickness on the mask layer 16 and on the surface of the deep trench.

6. *Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shen in view of Aussilhou as applied to claim 21 above, and further in view of Wang et al. (US 4,872,947).*

As discussed above, Shen discloses forming the collar oxide layer 35 using a CVD process. Whereas Shen discloses performing the CVD process using TEOS as a reactive gas, Shen does not teach performing the CVD process using both TEOS and ozone (O<sub>3</sub>) as reactive gases, as recited in claim 22.

The Wang et al. patent (Wang) discloses a method of forming an oxide layer (col. 19, line 67 – col. 21, line 36). The method comprises forming the oxide layer using a CVD process, wherein the CVD process comprises using O<sub>3</sub> and TEOS as reactive gases (col. 20, lines 14-42).

Since both Shen and Wang are from the same field of endeavor, the purpose for which Wang is relied upon would have been recognized in the prior art reference of Shen by one of ordinary skill in the art at the time the invention was made.

The CVD process of Wang is a thermal CVD process, which comprises using O<sub>3</sub> and TEOS at a low temperature and a high pressure to deposit a highly conformal oxide layer (Wang col. 20, lines 33-41). The deposited highly conformal oxide layer fills in the voids, cusps, and other topographical irregularities such that a substantially planar surface is provided (Wang col. 20, lines 33-41). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the combination of Shen and Aussilhou in view of Wang by forming the collar oxide layer 35 using the CVD process taught by Wang, since the deposited oxide layer resulting from the CVD process is a highly conformal layer that fills in voids, cusps, and other topographical irregularities to provide a substantially planar surface within the deep trench 20.

***Allowable Subject Matter***

7. *Claims 1 and 13 would be allowable if rewritten or amended to overcome the rejection under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action. Claims 2-12 and 14-17 would be allowable if rewritten to overcome the rejection under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims. The claims would be allowable if rewritten as discussed above, since the prior art of record does not anticipate, teach, or suggest a method of fabricating a deep trench capacitor, the method comprising the steps of: depositing a material into the deep trench to form a material layer; removing a portion of the material layer*



Art Unit: 2822

inside the deep trench to form a first opening; removing the collar oxide layer not covered by the material layer; removing a portion of the mask layer on the sidewall of the first opening to form a second opening, wherein the second opening has a width greater than the first opening; and removing the material layer.

8. *Claims 23-25 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, and rewritten to overcome the rejection under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action.* The claims would be allowable if rewritten as discussed above, since the prior art of record does not anticipate, teach, or suggest a method for fabricating a deep trench capacitor, the method comprising forming a collar oxide on the surface of a protective layer such that the protective layer has a removal rate smaller than the collar oxide layer.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Toniae M. Thomas whose telephone number is (571) 272-1846. The examiner can normally be reached on Monday-Thursday from 8:30 a.m. to 5:30 p.m..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 2822

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

*MMJ*

22 August 2004



**Mary Wilczewski**  
**Primary Examiner**